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Public Buildings Enhanced Energy Efficiency Program

Final Report
Investigation Results For
Health and Agriculture Laboratory

Date: 6/22/2012
Revised 09/18/2012

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DEPARTMENT OF ADMINISTRATION

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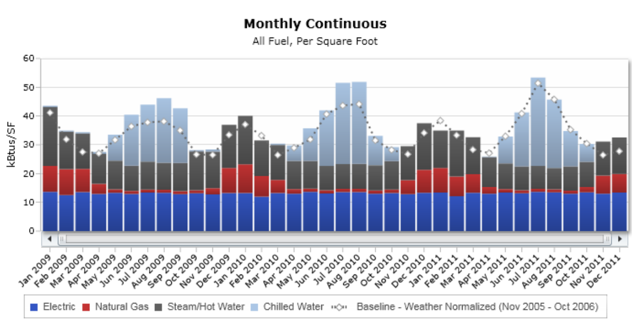
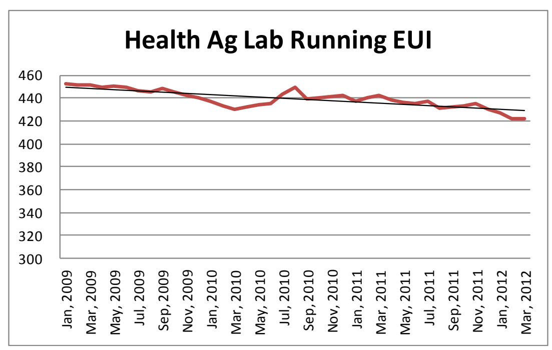
Health and Agriculture Laboratory Energy Investigation Overview

The goal of a PBEEEP Energy Investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. During the investigation phase the provider conducts a rigorous analysis of the building operations. Through observation, targeted functional testing, and analysis of extensive trend and portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. The investigation of Health and Agriculture Laboratory was performed by Karges, Faulconbridge, Inc. This report is the result of that information.

Payback Information and Energy Savings				
Total project costs (Without Co-funding)			**Project costs with Co-funding**	
Total costs to date including study	$33,803		Total Project Cost	$47,243
Future costs including Implementation , Measurement & Verification	$13,440		Study and Administrative Cost Paid with ARRA Funds	($18,750)
Total Project Cost	$47,243		Utility Co-funding	($18,750)
			Total costs after co-funding	$8,310
Estimated Annual Total Savings ($)	$29,469		Estimated Annual Total Savings ($)	$29,469
Total Project Payback	1.6		Total Project Payback with co-funding	N.A.
Electric Energy Savings 0.4 %		**District Heat Savings 5.9%**		**District Chilled Water Savings 0.8 %**





Health and Agriculture Laboratory Consumption Report
Total energy use decreased 3% during the period of the investigation

Year	Days	SF	Total kBtu	Normalized Baseline kBtu	Change from Baseline kBtu	% Change	Total Energy Cost $	Average Cost Rate $ /kBtu
2009	365	181,109	79,787,459	71,251,718	8,535,742	12%	$1,257,270.96	$0.02
2010	365	181,109	80,075,485	73,662,426	6,413,059	9%	$1,329,448.38	$0.02
2011	365	181,109	77,946,363	75,743,697	2,202,665	3%	$1,393,824.11	$0.02

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Summary Tables

Health and Agriculture Laboratory	
Location	601 Robert Street North, Saint Paul MN 55155
Facility Manager	Gene Peterman
State's Project Manager	Harvey Jaeger
Interior Square Footage	181,109
PBEEEP Provider	Karges, Faulconbridge, Inc.
Annual Energy Cost	$1,393,824 (2012) Source: B3
Utility Company	Xcel Energy (electric and gas) St Paul District Energy(steam and chilled water)
Site Energy Use Index (EUI)	442 kBtu/ft2 (at start of study) 425 kBtu/ft2 (at end of study)
Benchmark EUI (from B3)	301 kBtu/ft2

Building Name	**State ID**	**Area (Square Feet)**	**Year Built**
Health Agriculture Laboratory	G02310271	181,109	2005

Mechanical Equipment Summary Table (of buildings included in the investigation)

Quantity	**Equipment Description**
1	Building Automation System (Honeywell EBI for State Capitol Complex)
11	Air Handlers
267	VAV Boxes (113 with reheats and 154 without)
317	Exhaust VAV boxes (296 for fume hoods)
22	Exhaust fans
12	FCUs
8	Water to Water Heat Exchangers
3	Hot Water Pumps
3	Chilled Water Pumps
1	Process Chiller
2	Process chiller pumps
2	Dry Coolers
8	Hot water pumps for AHU coils
2	Steam Generators
7	CUHs
3	HUHs
4	VUHs
3	Power Roof Ventilators
2	Transfer Fans
750	Approximate number of points for trending

Implementation Information			
Estimated Annual Total Savings ($)			$29,469
Total Estimated Implementation Cost ($)			$10,440
GHG Avoided in U.S Tons (CO2e)			137
Electric Energy Savings (kWh) 0.4 % Savings 2011 Electric Usage 8,404,420 kWh (from B3)			33,033
District Heating Savings 5.9% Savings 2011 District Heating Usage 22,906 MMBtu (from B3)			1,358
District Cooling Savings 0.8 % Savings 2011 District Cooling Usage 18,362 MMBtu (from B3)			148
Statistics			
Number of Measures identified			4
Number of Measures with payback < 3 years			3
Screening Start Date	10/28/2010	Screening End Date	2/28/2011
Investigation Start Date	5/23/2011	Investigation End Date	4/3/2012
Final Report	6/22/2012		

Health and Agriculture Laboratory Cost Information			
Phase		**To date**	**Estimated**
Screening		$2,683	
Investigation [Provider]		$25,000	
Investigation [CEE]		$6,120	$1,000
Implementation			$10,440
Implementation [CEE]			$1,000
Measurement & Verification		0	$1,000
Total		$33,803	$13,440

Co-funding Summary	
Study and Administrative Cost	$36,803
Utility Co-Funding - Estimated Total ($)	$18,750
Total Co-funding ($)	$55,553

Facility Overview

The energy investigation identified 2.1 % of total energy savings at Health and Agriculture Laboratory with measures that payback in less than 15 years and do not adversely affect operations or occupant comfort. The energy savings opportunities identified at Health and Agriculture Laboratory are optimizing the operations of the heat wheels in the building, reducing fan run times in unoccupied mechanical rooms and replacing 32 W lamps with 28 watt lamps. The total cost of implementing all the measures is $10,440.

Implementing all these measures can save approximately $29,469 a year with a combined payback period of 4 months before rebates based on the implementation cost only (excluding study and administrative costs). These measures will produce 0.4% electrical savings, 5.9 % district hot water steam savings and 0.8% district chilled water savings.

Mechanical Equipment

The building is conditioned by hot and chilled water from St. Paul District Energy. The hot water is available year-round and the chilled water is available from April 1st to November 1st each year. District hot water is brought into the basement of the building where it is then run through 8 water to water heat exchangers. The water is circulated through the building by 3 hot water pumps. The district chilled water is also brought into the basement, but there are no heat exchangers in the chilled water loop. The district chilled water is pumped directly to the air handlers to provide cooling by three chilled water pumps.

There are 6 large AHUs which supply air to and exhaust air from the labs. The units are 100% outside air (OA) and contain energy recovery wheels to capture energy from the exhaust air. These six AHUs contain a total of 267 VAV boxes. Of the 267 boxes, 113 supply ventilation air to the spaces to maintain space temperature, these boxes contain reheat coils. The remaining 154 VAV boxes supply air directly from the AHUs to the fume hoods to make up for air which is exhausted out of the fume hoods. There are also 317 exhaust VAV boxes associated with these 6 AHUs. There are 296 fume hoods which exhaust air out of the lab spaces. It is estimated 50% of these units cannot vary the exhaust volume. The remaining 21 exhaust VAV boxes exhaust the supply air from the lab. These boxes can vary their volume from 0 to the maximum design exhaust flow. There are also 4 smaller constant volume AHUs which serve mechanical, electrical, and grinding rooms.

The building has a lab that contains highly contagious pathogens. This part of the building is separated from the other parts of the building. It contains its own dedicated AHU and exhaust fans which exhaust the air out of the lab. The AHU is 100% OA with no energy recovery. The water which is used in this lab is also disposed of within a water treatment system located in the basement. It requires the water to be heated to 240 ºF and stored for a period of time before it is disposed.

There is also a process chiller which supplies cold water to labs for various experiments. The chiller is air cooled and contains 2 chilled water pumps.

Controls and Trending

The building runs on a Honeywell EBI R310.1 Building Automation System (BAS), which is part of the State Capitol Complex system. The Plant Management Division (PMD) of the Department of Administration controls the BAS. PMD will set up all trending required for the project based on the direction of the recommissioning provider. The trend data is exported in a standard format such as csv. All equipment in the building is DDC, except for fire dampers which are pneumatically controlled. The points on the automation system for the mechanical equipment are listed in the following Building Summary Table.

Lighting

Indoor lighting- Interior lighting consists of T8 32 watt and T5 lights. The hallways, open offices with cubicles, and lab spaces are T8 lights. The closed office spaces are T5. It is approximately 80% T8 lighting and 20% T5. These lights are controlled by a Lutron ® lighting system. The lights are on a schedule and are off when occupants are not in the space. There are also occupancy sensors for offices which will shut the lights off if there are no occupants in the space. Mechanical rooms and areas used by building facility staff are controlled by light switches. Fume hoods contain mainly T8 32 watt lighting. About 2% of the fume hoods in the building do contain T12 40 watt lights. It is not known why these hoods contain T12s.

Outdoor lighting- The outdoor lighting consists of high pressure sodium (HPS) and metal halide lighting. The outside lighting which is more decorative consists of metal halide. These lights are also on the Lutron system and are controlled by a photocell and timer.

Energy Use Index B3 Benchmark

The site Energy Use Index (EUI) for the building is 425 kBtu/sqft, which is 41% higher than the B3 Benchmark of 301 kBtu/sqft. The benchmark is probably not correct for this site which has a specialized use. The site EUIs for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks on average.

Metering

The building contains two electrical meters, one hot water meter for district hot water, one chilled water meter for district chilled water, and one natural gas meter.

Findings Summary

Building: Health Agriculture Laboratory
Site: Health Agriculture Lab

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
4	Reduce AHU - 9 fan run time (mechanical penthouse)	$100	$1,971	0.05	$0	0.05	25
6	Optimize winter heat wheel operations	$3,420	$25,802	0.13	$0	0.13	99
1	Correct heat wheel operation between 55 and 70 degrees	$3,420	$1,330	2.57	$0	2.57	9
7	Replace T-8 32 watt lamps with 28 watt lamps	$3,500	$367	9.53	$292	8.74	4
	Total for Findings with Payback 3 years or less:	**$6,940**	**$29,102**	**0.24**	**$0**	**0.24**	**134**
	Total for all Findings:	**$10,440**	**$29,469**	**0.35**	**$292**	**0.34**	**137**

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14100 - Health Agriculture Laboratory

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	**a.1 (1)**	Time of Day enabling is excessive	No		Not Relevant	The building essentially runs 24 hours per day. The building is pretty much unoccupied after 6 pm with a few staying late. However, there are critical pressure relationships in this building. The offices have to be negatively pressurized to the lab area, which requires main ahu's to operate 24 hours per day. It seems the pressure relationship was a very difficult item to get operating correctly and should not be played with. There is a smaller unit in the mechanical penthouse that might be adjusted.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	YES			The H&A lab runs one of their units different than the initial sequence. They made this change. Based on how they now operate the unit, the sequencing can be tweaked easily at no cost and save them fan run time.
	a.3 (3)	Lighting is on more hours than necessary.	No		Investigation looked for, but did not find this issue.	The installed data loggers in random lab areas indicates the lights go off and on with a schedule.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling	No		Not Relevant	
b. Economizer/Outside Air Loads:	**b.1 (5)**	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	Yes			On the 6 main air handling units. Controls need to be tuned.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	Yes	AHU-10		Based on the exhaust in the area, the minimum of 25% in the winter is too high. This unit should never require heating based on the constant internal loads. Supply too cold in the winter for load. Min OA can be much less to cover local exhaust and there is no occupancy in this area.
	b.3 (7)	OTHER_Economizer/OA Loads	NO		Investigation looked for, but did not find this issue.	The amount of outdoor air brought into the building is a delicate balance with all of the exhaust that is required. The building is naturally over ventilated based on its use.
c. Controls Problems:	**c.1 (8)**	Simultaneous Heating and Cooling is present and excessive	??			We did see some cooling valves open when the heating valves were open but the discharge temperatures did not indicate that there was water flowing. Looked like simultaneous heating and cooling but likely was not.
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	Yes			The OA RH sensor should be checked. The readings look suspicious. Did not include in any calculations. This is a maintenance item.
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints	No		Not Relevant	
	c.4 (11)	OTHER_Controls	NO		Not Relevant	
	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	No			No Daylighting control. Areas that have large windows are missing lamps and not going to replace them. Very little lighting in these areas.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	No		Not Relevant	There are some temperature variations in the rooms. Some are warmer than others. The majority of the areas that are included are in interior lab areas. Occupant comfort was an important issue to the owner when we asked about them. Do not feel that any temperature changes would be permanent.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	NO			Fans vary speed as they can to maintain required space pressures.

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d. Controls (Setpoint Changes):	d.4 (15)	Pump Speed Doesn't Vary Sufficiently	No		Investigation looked for, but did not find this issue.	The DP's for all pumps are reasonable and the pump speeds do show some variance.
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	No			VAV's assist in the building pressure control. The operation of the building is dependent on pressure relationships. They have this dialed in and we do not feel it should be adjusted. They mentioned it took a very long time to set this up correctly the first time and we feel it should be left alone. This is a special building and the building function should outweigh small energy savings.
	d.6 (17)	Other_Controls (Setpoint Changes)	Yes	Humidifiers		The building is kept at 25% RH in the winter. We have calculated scenarios of building temperature set point and slightly lower RH's. The savings are significant with no expected effect on the occupants.
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal	No		Investigation looked for, but did not find this issue.	Temperatures reset
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal	No			Did not investigate this measure. Humidity control is important in some areas of the building and internal heat gains are high and constant in the interior labs. i.e. the DAT set points from all Labs is 55 year round; constant heat gain from internal loads.
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	NO			Interior heat gains dominate a large portion of the buiding. The labs are fitted with equipment that generates large heat gains. The amount of equipment is not data center levels but is significant. These areas are typically located in interior zones and will require cooling year round.
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal	No			Duct static is used to maintain buidling pressurization. Trends indicate the air volumes in AHU 1-6 do change as space conditions change.
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal	NO			No cooling towers
	e.6 (22)	Other_Controls (Reset Schedules)	No			
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit	No	Atrium	Not Relevant	There is limited opportunity in the atrium area. The building staff has reduced the foot candles in this area by not replacing lamps as they burn out. They are in tune with this area and understand the lighting levels.
	f.2 (24)	Pump Discharge Throttled	No			Pumps are on VFD's and set by the balancer.
	f.3 (25)	Over-Pumping				
	f.4 (26)	Equipment is oversized for load.	Yes	AHU-10 and AHU-9		The units are likely oversized but not likely to be replaced. We have included some quick modifications to the operation to hopefully make them operate better for the space.
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction	??			
	g.1 (28)	VFD Retrofit - Fans	NO		Not Relevant	All cases of variable volume have VFDs installed and are operational.

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Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	**g.2 (29)**	VFD Retrofit - Pumps	No		Investigation looked for, but did not find this issue.	Pumps have reasonable DP set points and the pumps vary speed.
	g.3 (30)	VFD Retrofit - Motors (process)	NO		Not Relevant	
	g.4 (31)	OTHER_VFD	NO		Not Relevant	
h. Retrofits:	**h.1 (32)**	Retrofit - Motors	NO		Not Relevant	Motors that are installed are high efficiency. Could replace with premium efficiency as they burn out.
	h.2 (33)	Retrofit - Chillers	No		Not Relevant	No Chillers
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)	NO		Not Relevant	This is a relatively new building. Replacement of equipment is not needed for age.
	h.4 (35)	Retrofit - Boilers	No		Not Relevant	No Boilers on site
	h.5 (36)	Retrofit - Packaged Gas fired heating	NO		Not Relevant	No gas fired equipment.
	h.6 (37)	Retrofit - Heat Pumps	NO		Not Relevant	No heat pumps
	h.7 (38)	Retrofit - Equipment (custom)	NO		Not Relevant	
	h.8 (39)	Retrofit - Pumping distribution method	Maybe	AHU 1-6		We will look at the circulation pumping at the units when heating season is here.
	h.9 (40)	Retrofit - Energy/Heat Recovery	Maybe	AHU 1-6		Will fully evaluate the effectiveness of the heat recovery at heating season. Expect a minimum of 60% efficiency from a heat wheel. If less than 70%, will investigate fully.
	h.10 (41)	Retrofit - System (custom)	Yes			Could add heat recover to hazardous exhaust fans. Fans exhaust 30,000 cfm every minute of the year. However this is an item that requires almost complete engineering to implement. We have marked what we feel the energy recovery could be. Will include in the Xcel report as an item that may qailify for further engineering study.
	h.11 (42)	Retrofit - Efficient Lighting	Yes/NO			Lab area lighting should be left as designed. Office spaces might be able to be retrofitted with 28 W lamps instead of 32. Will verify with total count of office spaces.
	h.12 (43)	Retrofit - Building Envelope	NO		Not Relevant	New Building. No obvious signs of envelope breeches.
	h.13 (44)	Retrofit - Alternative Energy	NO		Not cost-effective to investigate	PV would be the only source available at this site. Have been part of three LEED projects in the past year and the payback is not attractive. Only used when buying a LEED point.
	h.14 (45)	OTHER_Retrofit	Yes	Exhaust Fans		Heat recovery at the exhaust fans. 30,000 cfm available on a 24 hour basis. Found coils for run around loop that can withstand 2-13 PH levels.
i. Maintenance Related Problems:	**i.1 (46)**	Differed Maintenance from Recommended/Standard	NO		Not Relevant	
	i.2 (47)	Impurity/Contamination	NO			
	i.3 ( )	Leaky/Stuck Damper	NO			
	i.4 ( )	Leaky/Stuck Valve	No			Did not see evidence of valves leaking at a noticeable rate.
	i.5 (48)	OTHER_Maintenance	Yes			The F&B dampers on AHU-9 and AHU-10 show full face but the DAT's off the coils at times do not seem to reflect full face. No calculations performed on these dampers. Did not feel that we could provide calculations that would stand up to review.

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j. OTHER	**j.1 (49)**	OTHER	Yes			The recirc pumps at AHU-1 through AHU-6 are installed per the schematic but not the detail. Unclear if the pumps are actually required for system operation. Pumps are very small and savings are expected to be minimal. No calculations on these pumps.

Findings Glossary: Findings Examples

a.1 (1)	**Time of Day enabling is excessive**
	• HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	**Equipment is enabled regardless of need, or such enabling is excessive**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	**Lighting is on more hours than necessary**
	• Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	**OTHER Equipment Scheduling and Enabling**
	• Please contact PBEEEP Project Engineer for approval
b.1 (5)	**Economizer Operation – Inadequate Free Cooling**
	• Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	**Over-Ventilation**
	• Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	**OTHER Economizer/Outside Air Loads**
	• Please contact PBEEEP Project Engineer for approval
c.1 (8)	**Simultaneous Heating and Cooling is present and excessive**
	• For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	**Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement**
	• OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	**Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints**
	• CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	**OTHER Controls**
	• Please contact PBEEEP Project Engineer for approval
d.1 (12)	**Daylighting controls or occupancy sensors need optimization**
	• Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	**Zone setpoint setup / setback are not implemented or are sub-optimal**
	• The cooling setpoint is 74 ºF 24 hours per day
d.3 (14)	**Fan Speed Doesn't Vary Sufficiently**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	**Pump Speed Doesn't Vary Sufficiently**	
		• Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	**VAV Box Minimum Flow Setpoint is higher than necessary**	
		• Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	**Other Controls (Setpoint Changes)**	
		• Please contact PBEEEP Project Engineer for approval
e.1 (18)	**HW Supply Temperature Reset is not implemented or is sub-optimal**	
		• HW supply temperature is a constant 180 ºF. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	**CHW Supply Temperature Reset is not implemented or is sub-optimal**	
		• CHW supply temperature is a constant 42 ºF. It could be reset, based on demand or ambient temperature.
e.3 (20)	**Supply Air Temperature Reset is not implemented or is sub-optimal**	
		• The SAT is constant at 55 ºF. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ( )	**Supply Duct Static Pressure Reset is not implemented or is suboptimal**	
		• The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	**Condenser Water Temperature Reset is not implemented or is sub-optimal**	
		• CW temperature is constant leaving the tower at 85 ºF. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	**Other Controls (Reset Schedules)**	
		• Please contact PBEEEP Project Engineer for approval
f.1 (23)	**Lighting system needs optimization - Spaces are overlit**	
		• Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	**Pump Discharge Throttled**	
		• The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	**Over-Pumping**	
		• Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	**Equipment is oversized for load**	
		• The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	**OTHER Equipment Efficiency/Load Reduction**
	• Please contact PBEEEP Project Engineer for approval
g.1 (28)	**VFD Retrofit Fans**
	• Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	**VFD Retrofit - Pumps**
	• 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	**VFD Retrofit - Motors (process)**
	• Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	**OTHER VFD**
	• Please contact PBEEEP Project Engineer for approval
h.1 (32)	**Retrofit - Motors**
	• Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	**Retrofit - Chillers**
	• Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	**Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)**
	• Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	**Retrofit - Boilers**
	• Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	**Retrofit - Packaged Gas-fired heating**
	• Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	**Retrofit - Heat Pumps**
	• Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	**Retrofit - Equipment (custom)**
	• Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	**Retrofit - Pumping distribution method**
	• Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	**Retrofit - Energy / Heat Recovery**
	• Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	**Retrofit - System (custom)**
	• Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	**Retrofit - Efficient lighting**
	• Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	**Retrofit - Building Envelope**	
		• Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	**Retrofit - Alternative Energy**	
		• Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	**OTHER Retrofit**	
		• Please contact PBEEEP Project Engineer for approval
i.1 (46)	**Differed Maintenance from Recommended/Standard**	
		• Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	**Impurity/Contamination**	
		• Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ( )	**Leaky/Stuck Damper**	
		• The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ( )	**Leaky/Stuck Valve**	
		• The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	**OTHER Maintenance**	
		• Please contact PBEEEP Project Engineer for approval
j.1 (49)	**OTHER**	
		• Please contact PBEEEP Project Engineer for approval

Findings Details

Building: Health Agriculture Laboratory

FWB Number:	14100	Eco Number:	1
Site:	Health Agriculture Lab	Date/Time Created:	6/22/2012

Investigation Finding:	Correct heat wheel operation between 55 and 70 degrees	Date Identified:	10/13/2011
Description of Finding:	Heat Wheel Economizer Control: The heat wheels have been shown to operate when the temperature of the exhaust air is greater than the temperature of the outdoor air. AHU1-6 have DAT's of 55 degrees for constant cooling load in the building due to heavy internal gain. When the wheels operate between 55 and approximately 70 degrees, the net result is using more chilled water to meet the set point of 55 degrees. There are no bypasses at the wheels but the wheel should be stopped with the exception of a purge or clean from time to time. Savings can be expected by stopping the energy recovery wheel between 55 and 70 degrees. This is not consistent across the trending. The wheels have internal Enthalpy control per the manufacturer. Some of the units operate better than others within this ECO.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Other Economizer/OA Loads		

Implementer:	Control Contractor or building staff if they are capable.	Benefits:	Heat wheel is detrimental when operated between 55 and 70 degrees. Actually increases the air temperature and the DAT is 55 degrees.
Baseline Documentation Method:	Trend data shows temperature rise across the wheels at times when there should be no temperature rise if there were either no wheel or the wheel was not in motion.		
Measure:	Lock out the wheel between 70 degrees and 55 degrees. These points should be adjustable by the operator.		
Recommendation for Implementation:	The heat wheel control sequences for AHU-1, 2, 3, 4, 5, and 6 will be modified to shut down when the OAT is between 55 F and 70 F. These points will be programmed into the automation system and be adjustable by the owner. Once the OA temperature is above 70 or below 55 F the wheel will engage. Humidity levels will be monitored and if they become too high, the wheel will engage to try and help reduce the latent loads. The relative humidity sensor will have to be checked to assure they are accurate frequently.		
Evidence of Implementation Method:	The follow points for AHU-1, 2, 3, 4, 5, and 6 will be trended for a two week period when the OAT is between 55 and 70 F: OA damper command, OAT, Heat wheel DAT, Heat coil pump status, Heat valve %, chilled water valve %, unit DAT, RAT, heat wheel exhaust temperature, heat wheel RPM, and DARH. These points will be trended to verify the wheel does not turn on when it is not required too.		

Annual District Energy-Chilled Water Savings (kBtu):	147,727	Contractor Cost ($):	$3,420
Est Annual District Energy-Chilled Water Savings ($):	$1,330	PBEEEP Provider Cost for Implementation Assistance ($):	$0
		Total Estimated Implementation Cost ($):	$3,420

Estimated Annual Total Savings ($):	$1,330	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	2.57	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	2.57	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	9	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	4.5%	Percent of Implementation Costs:	32.8%

Findings Details

Building: Health Agriculture Laboratory

FWB Number:	14100	Eco Number:	4
Site:	Health Agriculture Lab	Date/Time Created:	6/22/2012

Investigation Finding:	Reduce AHU - 9 fan run time (mechanical penthouse)	Date Identified:	10/13/2011
Description of Finding:	AHU-9 was designed to provide heating and cooling to the mechanical penthouse. The original finding was based on the design documents and the total OA required at max combustion air to the space. Since the original finding, we have definitively seen that the unit sequence has been changed and the OA damper is closed for the vast majority of the time to a 100% closed position. Based on the current sequence of the unit, the space temperatures, return air temperatures, the unit should not be run 24 hours per day. We believe that the space is negative to the building below because AHU-11 (essentially a fan) provides constant combustion air to the process steam generators and the water heaters 24 hours per day. In addition, we believe there is enough duct leakage within the space that the space temperature remains relatively constant. This combined with a newer envelope results in a low load condition on the air handling unit (this can be demonstrated in the trends when the RAT versus SAT are examined). It is obvious that the original design was based off 3/4 cfm/square foot was used and is likely too high for the space. The exercise in the ECO is to improve the existing operation. We moved forward with the assumption that the current operation is acceptable to the owner (they provided the information that they changed the control sequence). Based on our block load of the space using MN energy code walls and roofs, the fan run time can be reduced by 40% by setting the unit in unoccupied mode at all times and allowing it to cycle on and off as necessary to maintain set points. For the purposes of the calculations, we only included the fan reduced run time in the calculation. We did not feel that we could accurately determine the difference in the actual cooling or heating BTU's to the point that the Calculation could be justified under the PBEEEP program.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Facility staff	Benefits:	Reduce electrical usage for fan power.
Baseline Documentation Method:	Based from sequence of operation as described in the plans and from building staff. Trend data confirms the fan is on 100% of the time. There is a blip that shows the fan off. This was a communication error in the trend data as confirmed by building staff. The fan CFM is consistent with the exception of only a few trend points.		
Measure:	Set AHU-9 to unoccupied mode. The unit will cycle only when necessary to maintain space set points. Set the space temps to 75 cooling and 60 for heating in lieu of 68 and 72 degrees.		
Recommendation for Implementation:	Schedule AHU-9 for 24 hours a day seven days a week. During the summer the unit will initiate during unoccupied times if the space temperature rises above 75 F. During the winter if the space temperature falls below 60 F the unit will initiate. When the unit engages, the OA dampers will remain closed, the RA dampers will be 100% open and the unit will cycle air and treat it will the cooling coil or heating coil to satisfy the space temperature.		
Evidence of Implementation Method:	The following points will be trended on AHU9: OA damper%, MAT, heat valve %, chilled water valve %, face bypass dampers, SA CFM, SF stat, DAT, RAT, and OAT. The points will be trended to verify the proper sequences are followed.		

Annual Electric Savings (kWh):	29,033	Contractor Cost ($):	$100
Estimated Annual kWh Savings ($):	$1,971	PBEEEP Provider Cost for Implementation Assistance ($):	$0
		Total Estimated Implementation Cost ($):	$100

Estimated Annual Total Savings ($):	$1,971	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.05	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.05	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	25	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	6.7%	Percent of Implementation Costs:	1.0%

Findings Details

Building: Health Agriculture Laboratory

FWB Number:	14100	Eco Number:	6
Site:	Health Agriculture Lab	Date/Time Created:	6/22/2012

Investigation Finding:	Optimize winter heat wheel operations	Date Identified:	2/3/2012
Description of Finding:	The heat transfer across the heat wheel within AHU-1, AHU-2, AHU-3, AHU-4, AHU-5, and AHU-6 is sub-optimal on many occasions during the winter time. The unit has a DAT setpoint of 55 F and the DAT off the wheel is much lower then it should be. Heating savings will occur if the heat wheel operates properly.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Other_Controls (Setpoint Changes)		

Implementer:	Controls Contractor	Benefits:	Reduced need for heating.
Baseline Documentation Method:	Looked at trending of OAT versus leaving wheel temperatures and calculated the effectiveness. The theoretical design (78%) should prevent the heating coils from ever being required. Obviously this is not the case based on the trending. We have seen one of the units operate at 62% effectiveness. The other units were operating below 60%. We have used 60% as the baseline that we feel is achievable from tuning the wheel control. We saw the heating valves open at OA temperatures as high as the mid 40's. This should never happen with the wheels that are in place.		
Measure:	Tune controls to allow the wheels to control to a higher effectiveness. The installed equipment has a listed effectiveness of 78%. We feel that the wheels should be able to operate at a minimum of 60% effectiveness at all times.		
Recommendation for Implementation:	For AHU-1, 2, 3, 4, 5, and 6, the control contractor meets fine tune the controls on all heat wheels. The wheel should rotate at speeds that allow the mixed air temperature to reach or get as close to the DAT setpoint at any point when the OAT is less than the DAT SP. Some of the wheels perform better than others and the units are essential identical. The wheels should be cleaned as well to help increase the efficiency of the unit. Before any work by the control contractor is done, the actual cause as to why the heat wheels are working sub-optimal needs to be determined. The following points need to be graphed and engineering equations need to be performed to assure this finding is 100% accurate: OAT, Wheel DAT, RAT, Wheel Exhaust, and Wheel RPM. This needs to be looked at to determine what the current efficiency of the wheel is then why there is not as much heat transfer and there should be from the wheel.		
Evidence of Implementation Method:	The following points will be trended on AHU1, AHU2, AHU3, AHU3, AHU4, AHU5, and AHU6: OAT, Heat Wheel RPM, Heat Wheel DAT, RAT, Heat Wheel Exhaust temperature, face bypass damper, heat coil 1, heat coil 2, chilled water coil 1, chilled water coil 2, DAT1, DAT2, DAT3, DAT4, DAT5, DAT setpoint, duct static pressure, fan speed, and DARH. These points will be trended to assure the heat wheel is optimized during the winter. These points will be trended for a two week period when the OAT is 20 F and lower.		

Annual District Energy-Hot Water Savings (Gallons):	1,357,997	Contractor Cost ($):	$3,420
Est Annual District Energy-Hot Water Savings ($):	$25,802	PBEEEP Provider Cost for Implementation Assistance ($):	$0
		Total Estimated Implementation Cost ($):	$3,420

Estimated Annual Total Savings ($):	$25,802	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.13	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.13	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	99	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	87.6%	Percent of Implementation Costs:	32.8%

Findings Details

Building: Health Agriculture Laboratory

FWB Number:	14100	Eco Number:	7
Site:	Health Agriculture Lab	Date/Time Created:	6/22/2012

Investigation Finding:	Replace T-8 32 watt lamps with 28 watt lamps	Date Identified:	2/3/2012
Description of Finding:	Currently the common areas have T8 32 Watt lights. These lamps run during the occupied period of the building. There are more energy efficiency lights then T8 32 Watt lights, investigate switching the lamps out.		
Equipment or System(s):	Interior Lighting	Finding Category:	Retrofits
Finding Type:	Retrofit - Efficient Lighting		

Implementer:	Facility staff/Contractor	Benefits:	Reduce the overall lighting power required for the building.
Baseline Documentation Method:	Light counts of fixtures were taken and run times for the actual building hours were used for the calculations.		
Measure:	Replace fixtures identified in calculations and relamp fixtures with lower Wattage lamps as identified.		
Recommendation for Implementation:	Replace the T8 32 Watt lights with T8 28 Watt lights. There are also metal halide lamps which could be converted to more energy efficient lights, this area needs to be investigated more before it is done to assure it is feasible.		
Evidence of Implementation Method:	Verify changes have been made by observation. Provide paid invoices for new lamps and executed work orders. If possible take pictures of new lights.		

Annual Electric Savings (kWh): Estimated Annual kWh Savings ($):	4,270 $367	Contractor Cost ($): PBEEEP Provider Cost for Implementation Assistance ($): Total Estimated Implementation Cost ($):	$3,500 $0 $3,500

Estimated Annual Total Savings ($):	$367	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	9.53	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	8.74	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	4	Utility Co-Funding - Estimated Total ($):	$292

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.2%	Percent of Implementation Costs:	33.5%

PBEEEP
State Government

Project: **Health Agriculture Laboratory**

Deleted Findings Report

FWB Number:	14100	Eco #:	2	Building:	Health Agriculture Laboratory
Investigation Finding:	Reduce winter RH of building to 20%	Equipment or System(s):	AHU with heating and cooling		
Measure:	Change Humidity set points to 20% from 25% and maintain zones at a maximum of 72 degrees. Estimated cost of $100 saving 505 therms.				

FWB Number:	14100	Eco #:	3	Building:	Health Agriculture Laboratory
Investigation Finding:	Recover heat from hazardous exhaust stream with run around loop and coils.	Equipment or System(s):	Other		
Measure:	Recover heat from hazardous exhaust stream with run around loop and coils.				

FWB Number:	14100	Eco #:	5	Building:	Health Agriculture Laboratory
Investigation Finding:	Reduce outside air for AHU-10 (mechanical room)	Equipment or System(s):	AHU with heating and cooling		
Measure:	Set the minimum OA damper position at 1600 cfm. The unit should have a DAT set point of 72 degrees. Lock out cooling at OAT's of 70 degrees and below. The heat should never cycle on with the new minimum OA cfm. At that minimum, the mixed air temperature is never likely to drop below 58 degrees unless the OA conditions drop below the standard bin data of -21 degrees that was used in this calculation. Cost of $3,420 to save 225,673 kbtu chilled water and 9,873 btu hot water				

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce

Xcel Energy®

September 7, 2011

Gene Peterman
Health and Agriculture Laboratory
50 Sherburne Avenue G10
Saint Paul, MN 55155

Dear Mr. Peterman:

Thank you for participating in Xcel Energy's Recommissioning program. We have reviewed your study application and proposal and have preapproved your study. The following outlines your rebate and project information:

Building Address	**601 Robert Street North, Saint Paul, MN 55155**		
Study Cost	$25,000	Study Number	**RM1699**
Preapproved study rebate*	**$18,750**		
* Your rebate was based on the study cost provided. If the final study cost is lower, your rebate will be adjusted accordingly.			
Study Provider	**KFI**		
Account manager	**Barb Jerhoff**	Phone **651-229-5565**	

Here's a quick review of the Recommissioning program process:

- Once your study is complete, your study provider will send a draft copy to us for review.
- After we complete our review and approve the study, we will send you a confirmation letter noting our approval.
- Your study provider will schedule a wrap-up meeting with you and your Xcel Energy account manager to go over the results of the study.
- You pay the study provider for the full cost of the study.
- You submit the Recommissioning Study Rebate Application, along with a copy of the invoice and your Customer Implementation Plan, to us within 3 months of your report presentation. Please work with your account manager to complete the Customer Implementation Plan.
- We'll send your study rebate check to you.

Please note that we need to approve the final study in order to receive your study rebate.

This study pre-approval is valid for **3 months** from the date of this letter. If your study will take longer than that, please let us know. If you have any questions or comments, please call your assigned Xcel Energy account manager. Thanks again for participating in our Recommissioning program.

Sincerely,

Jon Packer
Marketing Assistant, Recommissioning

Attachment

CC: Barb Jerhoff - Xcel Energy
Sherryl Volkert - Xcel Energy
T. Patrick Johnson - KFI

PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

ATTACHMENT 4: SCREENING RESULTS FOR HEALTH AGRICULTURE LABORATORY

Admin Minnesota
DEPARTMENT OF ADMINISTRATION

January 28, 2011

Summary Table

Department of Health Agriculture Laboratory	
Location	601 Robert Street North, Saint Paul MN 55155
Facility Manager	Gene Peterman
Number of Buildings	1
Interior Square Footage	181,109
PBEEEP Provider	Center for Energy and Environment (Neal Ray)
State's Project Manager	Pat Ferrin
Date Visited	January 12, 2011
Annual Energy Cost (from B3)	$1,265,468 (2009)
Utility Company	District Energy St. Paul (Hot and Chilled Water), Xcel Energy (Natural Gas and Electricity)
Site Energy Use Index (from B3)	442 kBtu/sq ft(2009)
Benchmark EUI (from B3)	301 kBtu/sq ft

Screening Overview

The goal of screening is to select buildings where an in-depth energy investigation can be performed to identify energy savings opportunities that will generate savings with a relatively short (1 to 5 years) and certain payback. The screening of Health Agriculture Laboratory was performed by the Center for Energy and Environment (CEE) with the assistance of the facility staff. A walk-through was conducted on January12, 2011 and interviews with the facility staff were carried out to fully explore the status of the energy consuming equipment and their potential for recommissioning. This report is the result of that information.

The Health Agriculture Laboratory is a 181,109 square foot (sqft) building located in St. Paul, MN. The building consists of roughly 35% office space and 65% laboratory.

Recommendation for Investigation

An investigation of the energy usage and energy savings opportunities of the Health Agriculture Laboratory is recommended.

Building Name	State ID	Square Footage	Year Built
Health Agriculture Laboratory	G02310271	181,109	2005

Building Overview Section

Mechanical Equipment
The building is conditioned by hot and chilled water from St. Paul District Energy. The hot water is available year-round and the chilled water is available from April 1st to November 1st each year. District hot water is brought into the basement of the building where it is then run through 8 water to water heat exchangers. The water is circulated through the building by 3 hot water pumps. The district chilled water is also brought into the basement, but there are no heat exchangers in the chilled water loop. The district chilled water is pumped directly to the air handlers to provide cooling by three chilled water pumps.

There are 6 large AHUs which supply air to and exhaust air from the labs. The units are 100% outside air (OA) and contain energy recovery wheels to capture energy from the exhaust air. These six AHUs contain a total of 267 VAV boxes. Of the 267 boxes, 113 supply ventilation air to the spaces to maintain space temperature, these boxes contain reheat coils. The remaining 154 VAV boxes supply air directly from the AHUs to the fume hoods to make up for air which is exhausted out of the fume hoods. There are also 317 exhaust VAV boxes associated with these 6 AHUs. There are 296 fume hoods which exhaust air out of the lab spaces. It is estimated 50% of these units cannot vary the exhaust volume. The remaining 21 exhaust VAV boxes exhaust the supply air from the lab. These boxes can vary their volume from 0 to the maximum design exhaust flow. There are also 4 smaller constant volume AHUs which serve mechanical, electrical, and grinding rooms.

The building has a lab that contains highly contagious pathogens. This part of the building is separated from the other parts of the building. It contains its own dedicated AHU and exhaust fans which exhaust the air out of the lab. The AHU is 100% OA with no energy recovery. The water which is used in this lab is also disposed of within a water treatment system located in the basement. It requires the water to be heated to 240 ºF and stored for a period of time before it is disposed.

There is also a process chiller which supplies cold water to labs for various experiments. The chiller is air cooled and contains 2 chilled water pumps.

The following table lists the key mechanical equipment at the facility.

Mechanical Equipment Summary Table	
Quantity	**Equipment Description**
1	Honeywell EBI Automation System
1	Building
181,109	Interior Square Feet (before 1,200 sqft addition)
11	Air Handlers
267	VAV Boxes (113 with reheats and 154 without)
317	Exhaust VAV boxes (296 for fume hoods)
22	Exhaust fans
12	FCUs
8	Water to Water Heat Exchangers
3	Hot Water Pumps
3	Chilled Water Pumps
1	Process Chiller
2	Process chiller pumps
2	Dry Coolers
8	Hot water pumps for AHU coils
2	Steam Generators
7	CUHs
3	HUHs
4	VUHs
3	Power Roof Ventilators
2	Transfer Fans
750	Approximate number of points for trending

Controls and Trending

The building runs on a Honeywell EBI R310.1 Building Automation System (BAS), which is part of the State Capitol Complex system. The Plant Management Division (PMD) of the Department of Administration controls the BAS. PMD will set up all trending required for the project based on the direction of the recommissioning provider. The trend data is exported in a standard format such as csv. All equipment in the building is DDC, except for fire dampers which are pneumatically controlled. The points on the automation system for the mechanical equipment are listed in the following Building Summary Table.

Lighting

Indoor lighting- Interior lighting consists of T8 32 watt and T5 54 watt lights. The hallways, open offices with cubicles, and lab spaces are T8 lights. The closed office spaces are T5. It is approximately 80% T8 lighting and 20% T5. These lights are controlled by a Lutron ® lighting system. The lights are on a schedule and are off when occupants are not in the space. There are also occupancy sensors for offices which will shut the lights off if there are no occupants in the space. Mechanical rooms and areas used by building facility staff are controlled by light switches. Fume hoods contain mainly T8 32 watt lighting.

About 2% of the fume hoods in the building do contain T12 40 watt lights. It is not known why these hoods contain T12s.

Outdoor lighting- The outdoor lighting consists of high pressure sodium (HPS) and metal halide lighting. The outside lighting which is more decorative consists of metal halide. These lights are also on the Lutron system and are controlled by a photocell and timer.

Energy Use Index B3 Benchmark

The site Energy Use Index (EUI) for the building is 442 kBtu/sqft, which is 47% higher than the B3 Benchmark of 301 kBtu/sqft. The site EUIs for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks on average. This shows the Health Agriculture Laboratory may be a good candidate for a PBEEEP investigation.

Metering

The building contains two electrical meters, one hot water meter for district hot water, one chilled water meter for district chilled water, and one natural gas meter.

Documentation

There are as built prints dated October 14, 2004. There are also control submittals for mechanical equipment, mechanical submittals for all mechanical equipment, and operation and maintenance manuals for all equipment. There is also a testing and balancing report for all mechanical equipment available electronically.

Additional Information form Occupants Interviews and Observations

The following information **has not been verified** and was obtained through occupant interviews and/or general observations by the PBEEEP Screening team. This information is provided for reference only:

- This building contains two steam generators which are not on the automation system. They provide steam for processes and equipment such as dishwashers.
- The building contains a total of five power vent gas hot water heaters. Three of them are used for potable hot water use and have a setting of 140 ºF. The other two are used for domestic hot water and have a setting of 120 ºF.
- During heavy snows, the outside air dampers will pull snow in
- The six energy recovery wheels have an imbalance of exhaust and supply air. Some of the exhaust cannot be run through the wheel due to containments in the air
- There is a section in the building devoted for highly contagious pathogens. This area of the building is excluded from the remaining portions of the building. It has its own separate water which is disposed of through a waste water system and its own dedicated AHU.
- The AHU which serves the highly contagious pathogens was installed in 2006
- There are problems with air flow the highly contagious pathogens laboratory; due to how the duct work was installed it cannot exhaust air properly.
- All labs are kept at a slightly negative pressure.
- The two steam generators and 5 hot water heaters are not on the building automation system.

Important Note

The Health Agriculture Laboratory and Orville Freeman Office building in the state capitol complex are connected together by a skyway on the third floor. The buildings do not share the same mechanical equipment and the skyway contains doors to each building and limited interaction happens between the two buildings.

Reasons for Recommendation

This screening report is based on the PBEEEP Guidelines. It is based on one site visit, review of the facility documentation, building automation system, a limited inspection of the facility and interviews with the staff. The purpose of the screening report is to evaluate the potential of the facility for the implementation of cost-effective energy efficiency savings through recommissioning. To the best of our knowledge the information here is accurate. It provides a high level view of many of the important parameters of the mechanical equipment in the facility. Because it is the result of a limited audit survey of the facility, it may not be completely accurate or inclusive.

There are many factors that are part of the decision to recommend an energy investigation of a building. Some characteristics at the Health Agriculture Laboratory that were taken into account during the building selection process were:

- Potential energy savings opportunities observed during screening phase
- Large square footage
- Level of control by the building automation system
- Equipment size and quantity

One possible area which should be focused on during the investigation of the Health Agriculture Laboratory is the possibilities of either shutting down or slowing down some of the mechanical equipment in the spaces during unoccupied times. It is known the majority of the mechanical equipment cannot shut down due to exhaust requirements in the spaces 24 hours a day 7 days a week. However office areas and other areas which do not require exhaust could possibly have airflow reduced which would save fan energy at nights and possible the amount of OA the AHUs bring in.

Another reason for recommending this building for investigation is that the Energy Use Index (EUI) for the site is 46% higher than the B3 Benchmark EUI. The site EUIs for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks on average, which would indicate that the Health Agriculture Laboratory can possible reduce its energy use.

Building Summary Table

The following tables are based on information gathered from interviews with facility staff, a building walk-through, automation system screen-captures, and equipment documentation. The purpose of the tables is to provide the size and quantity of equipment and the level of control present in each building. It is complete and accurate to the best of our knowledge.

Health Agriculture Laboratory State ID# G02310271					
Area (sqft)	181,109	Year Built	2005	Occupancy (hrs/yr)	4,368
HVAC Equipment					

Air Handlers (11 Total)

Description	Type	Size	Notes
AHU 1	Heat recovery with VFD on SF and 2 EFs	50,000 CFM 100 HP	EF-1A and EF-1B are associated with this AHU
AHU 2	Heat recovery with VFD on SF and 2 EFs	50,000 CFM 100 HP	EF-2A and EF-2B are associated with this AHU
AHU 3	Heat recovery with VFD on SF and 2 EFs	50,000 CFM 100 HP	EF-3A and EF-3B are associated with this AHU
AHU 4	Heat recovery with VFD on SF and 2 EFs	50,000 CFM 100 HP	EF-4A and EF-4B are associated with this AHU
AHU-5	Heat recovery with VFD on SF and 2 EFs	50,000 CFM 100 HP	EF-5A and EF-5B are associated with this AHU
AHU-6	Heat recovery with VFD on SF and 2 EFs	50,000 CFM 100 HP	EF-6A and EF-6B are associated with this AHU
AHU-7A/B	2 SFs with VFDs		Serves MDA BSL. Works with EF-7C and EF-7D
AHU-9	Constant volume with face/bypass dampers	15,000 CFM 25 HP	
AHU-10	Constant volume with face/bypass dampers	17,000 CFM 20 HP	Contains two zones each with a reheat coil
AHU-11	Constant Volume	4,000 CFM 1.5 HP	Provides combustion air for boilers
AHU-12	Constant Volume	3,000 CFM 3 HP	Serves grinding room

VAV Boxes (267 Total)

Description	Type	Size	Notes
VAV 1B01-3B30 (113 boxes)	Reheats	200 to 1750 CFM	These VAV boxes are for supply conditioned air to the labs and spaces they serve.
VAV 1V01-4V02 (154 VAV boxes)	Air valves	100 to 4500 CFM	These boxes supply make up air to the fume hoods in the lab. It is estimated 50% of these boxes cannot vary airflow

HVAC Equipment Cont'd

Exhaust boxes(317 Total)

Description	**Type**	**Size**	**Notes**
1VE01-4VE03 (296 boxes)	Air valves	100 to 4,500 CFM	These boxes exhaust air from the fume hoods. It is estimated 50% of these boxes cannot vary airflow
1EB1-4EB3 (21 boxes)	Exhaust VAV boxes	1,500 to 4,600 CFM	These boxes exhaust air from the lab spaces (Flows can vary from 0 to maximum)

Exhaust Fans (22 Total)

Description	**Type**	**Size**	**Notes**
EF-1A and 1B	Upblast	21,250 CFM 30 HP	Laboratory exhaust. Associated with AHU-1
EF-2A and 2 B	Upblast	21,250 CFM 30 HP	Laboratory exhaust. Associated with AHU-2
EF-3A and 3 B	Upblast	21,250 CFM 30 HP	Laboratory exhaust. Associated with AHU-3
EF-4A and 4B	Upblast	21,250 CFM 30 HP	Laboratory exhaust. Associated with AHU-4
EF-5A and 5B	Upblast	21,250 CFM 30 HP	Laboratory exhaust. Associated with AHU-5
EF-6A and 6 B	Upblast	21,250 CFM 30 HP	Laboratory exhaust. Associated with AHU-6.
EF-7C and 7D	Variable volume	12,460 CFM 25 HP	Fans contain VFDs
EF-9A and 9B	Vertical	14,935 CFM 30 HP	Fans contain VFDs
EF-10A and 10B	Variable volume	2,615 CFM 10 HP	Fans contain VFDs
EF-11	Constant volume	3,500 CFM 1 HP	
EF-12	Constant volume	300 CFM 1/10 HP	
EF-13	Constant volume	700 CFM 1/6 HP	
EF-16	Variable volume	1,100 CFM 1 HP	Fan contains a VFD

HVAC Equipment Cont'd

Fan Coil Units (12 Total)

Description	Type	Size	Notes
FCU-1	Constant volume	4,000 CFM 5 HP	
FCU-2	Constant volume	1,600 CFM 1 HP	
FCU-3	Constant volume	1,620 CFM 1 HP	
FCU-4	Constant volume	1,620 CFM 1 HP	
FCU-5	Constant volume	1,600 CFM 1 HP	
FCU-6	Constant volume	800 CFM 1 HP	
FCU-7	Constant volume	1,000 CFM 1 HP	Cooling only unit
FCU-8	Constant volume	2,200 CFM 1.5 HP	Cooling only unit
FCU-9	Constant volume	1,000 CFM 1 HP	Cooling only unit
FCU-10	Constant volume	800 CFM 1 HP	
FCU-11	Constant volume	1,000 CFM 1 HP	Cooling only unit
FCU-12	Constant volume	1,000 CFM 1 HP	Cooling only unit

Hot Water System

Description	Type	Size	Notes
WHE-1 WHE-2 WHE-3 WHE-4 WHE-5 WHE-6 WHE-7 WHE-8	HW to HW Heat Exchanger	110 gpm of heated water 160 gpm of heating water	Heat exchanger for District HW and building preheat HW
Pump 7 Pump 8 Pump 9	Variable Volume HWPs	20 HP 430 gpm	In parallel, circulate HW
Pump-10 through Pump-15	Constant volume	2 HP 70 gpm	HW pumps for the HW coils on AHU-1 through AHU-6
Pump-18 and 19	Constant volume	1 HP 29 gpm	HW pumps for the HW coils on AHU-9 and 10

Chilled Water System

Description	Type	Size	Notes
Pump-4 Pump-5 Pump-6	Variable volume CHWPs	50 HP 1,140 gpm	3 CHWPs working with district chilled water

Steam Generators

Description	Type	Size	Notes
B-1 B-2		1380 lb_steam/hr	This unit is not on the automation system

HVAC Equipment Cont'd

Process Chiller Water

Description	Type	Size	Notes
Chiller-1	Air cooled	100 tons	
Dry Cooler 1	Liebert	170 gpm	
Dry Cooler 2	Liebert	170 gpm	
Pump-1 and 2	Constant volume	15 HP 340 gpm	

Dust Collector

Description	Type	Size	Notes
Dust Collector		3,000 CFM 7.5 HP SF	Serves the grinding area

CUH (7 total)

Description	Type	Size	Notes
CUH 1 through 7	Hot water	41 to 49 kBtu/hr	

VUH (4 total)

Description	Type	Size	Notes
VUH 1 through 4	Hot water	41 to 58 kBtu/hr	

HUH (3 total)

Description	Type	Size	Notes
HUH 1 through 3	Hot water	74 kBtu/hr	

Transfer Fans (2 total)

Description	Type	Size	Notes
TF-14	Horizontal	4,460 CFM 2 HP	
TF-15	Horizontal	2,000 CFM ¾ HP	

PRV (3 total)

Description	Type	Size	Notes
PRV-1	Constant volume	5,960 CFM 3 HP	Serves restrooms
PRV-2	Constant volume	1,700 CFM 1 HP	Serves restrooms
PRV-3	Constant volume	750 CFM 0.5 HP	Serves chemical storage

Points on BAS

Air Handlers

Description	Points
AHU-1 AHU-2 AHU-3 AHU-4 AHU-5 AHU-6	OAT, Heat Recovery Wheel RPM, Heat Wheel DAT, Face bypass damper %, HW valve %, HW coil DAT, CHW valve %, CHW coil DAT, Exhaust duct static pressure NW, Exhaust duct static pressure SW, Exhaust duct static pressure NE, Exhaust duct static pressure SE, Supply duct static pressure NW, Supply duct static pressure SW, Supply duct static pressure NE, Supply duct static pressure SE, EF status, Humidity valve %, DARH, SF status, SF speed, DAT, Space humidity floor 1, Space humidity floor 2, Space humidity floor 3, Exhaust fan status
AHU-7 A/B	HW coil pump status, HW valve 7A %, HW coil DAT 7A, CHW valve % 7A, SF status 7A, SF speed 7A, DAT 7A, Duct static pressure 7A, HW valve 7B %, HW coil DAT 7B, CHW valve % 7B, SF status 7B, SF speed 7B, DAT 7B, Duct static pressure 7B, DA RH
AHU-9	OA damper %, MAT, MA setpoint, Face bypass damper %, HW coil pump status, HW valve %, HW coil DAT, CHW valve %, SF CFM, SF status, DAT, RAT, Space temperature
AHU-10	OA damper %, MAT, MA setpoint, Face bypass damper %, HW coil pump status, HW valve %, HW coil DAT, CHW valve %, SF CFM, SF status, DAT, RAT, Zone temperature, Zone temperature reheat valve %
AHU-12	CHW valve %, SF status, DAT, RAT, Space humidity, Room temperature, Zone reheat %

Lab pressure

Description	Points
Lab	Space pressure, Space pressure setpoint

VAV Boxes

Description	Points
Each Unit	Max CFM, Actual CFM, Min CFM, Damper position, HW reheat valve, Heating setpoint, Room temp, Cooling setpoint

Fan Coil Unit

Description	Points
FCU-1 through FCU-12	Space temperature setpoint, Space temperature, Heating valve %, Cooling valve %, Fan status

Chilled Water System

Description	Points
System	District CHWST, District CHWRT, CHWST, Pump status, Pump speed, Differential pressure, District differential pressure, CHW valve % from district, System pump command, System pump speed, Building CHWST, Building CHWRT, CHW differential pressure 1, CHW differential pressure 2, CHW differential pressure setpoint, OA enable setpoint, CHW energy rate (kW), CHW flow

Points on BAS Cont'd

Process Chiller Water

Description	Points
System	OA setpoint, Pump-1 command, Pump-1 status, Pump-2 command, Pump-2 status, bypass valve %, CHWST, CHWRT, Differential pressure, Differential pressure setpoint

Hot Water System

Description	Points
System	Heating system enable, HW differential pressure 1, HW differential pressure 2, HW differential pressure setpoint, District HWST, District HWRT, Building HWST, Building HWRT, Water heat exchanger valve %, Pump-7 command, Pump-7 status, Pump-7 speed, Pump-8 command, Pump-8 status, Pump-8 speed, Pump-9 command, Pump-9 status, Pump-9 speed, HWST high limit, HWST low limit

CUH

Description	Points
CUH-1 through CUH-7	Space temperature setpoint, Space temperature, Valve %

VUH

Description	Points
VUH-1 through VUH-4	Space temperature setpoint, Space temperature, Valve %

HUH

Description	Points
HUH-1 through HUH-3	Space temperature setpoint, Space temperature, Valve %

FTR

Description	Points
All units (total of 10)	Space temperature setpoint, Space temperature, Valve %

Dust Collector

Description	Points
Dust Collector	Fan command, Fan status, DC air valve command

Points on BAS Cont'd

Plumbing System

Description	**Points**
Points	Potable hot water temperature, Non potable hot water temperature, Tempered hot water temperature, Sump 1 hi level alarm, Sump 2 hi level alarm, Sump 3 hi level alarm, Sewage ejector hi level alarm

PRV

Description	**Points**
PRV	Fan status

Transfer Fan

Description	**Points**
TF-14 and TF-15	Fan command, Fan status, Air valve command

Exhaust Fans

Description	**Points**
EF-10A and 10B EF-7A and 7B EF-9A and 9B	EF command, EF status, EF speed, Exhaust duct static pressure, Exhaust duct static pressure setpoint

Exhaust Fans

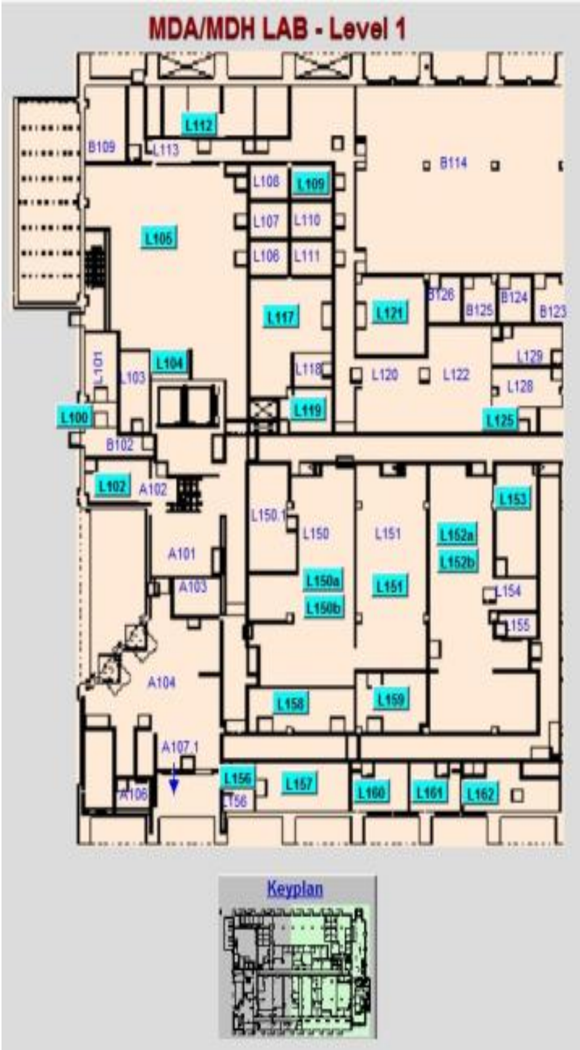
Description	**Points**
EF-11, 12, 13	Fan status

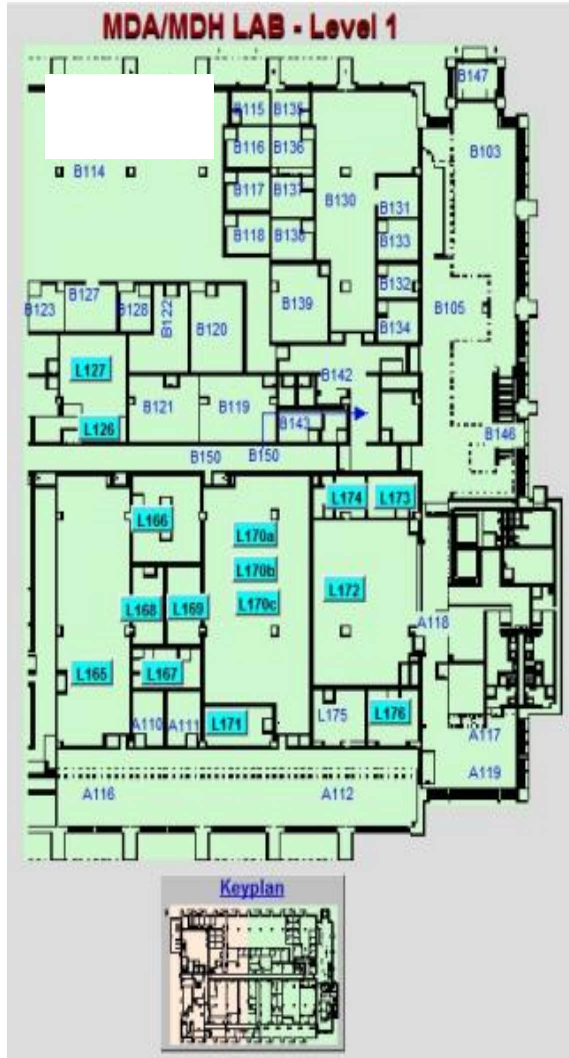
Exhaust Fans

Description	**Points**
EF-16	EF command, EF status, EF speed, Exhaust duct static pressure, Exhaust duct static pressure setpoint, Oxygen sensor 1%, Oxygen sensor 2%, Bio safety status

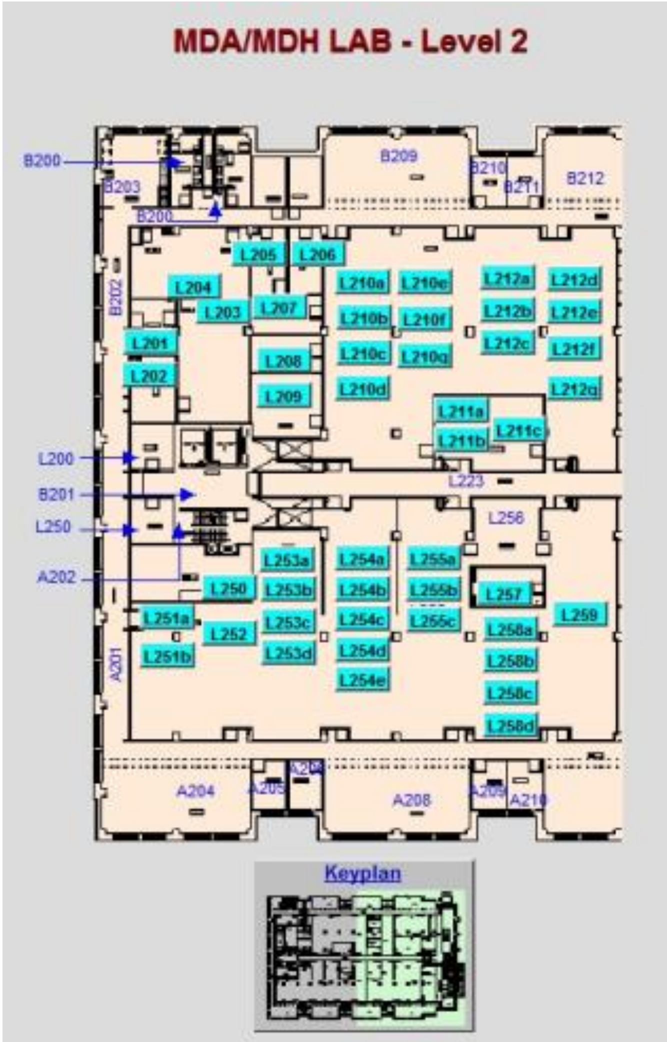
Building Floor Plans

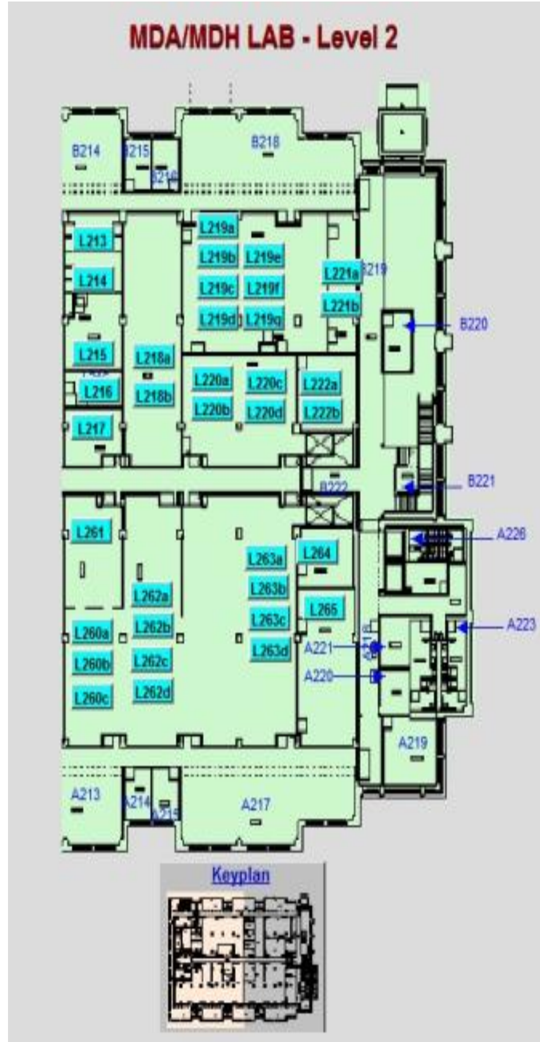
First Floor





Second Floor





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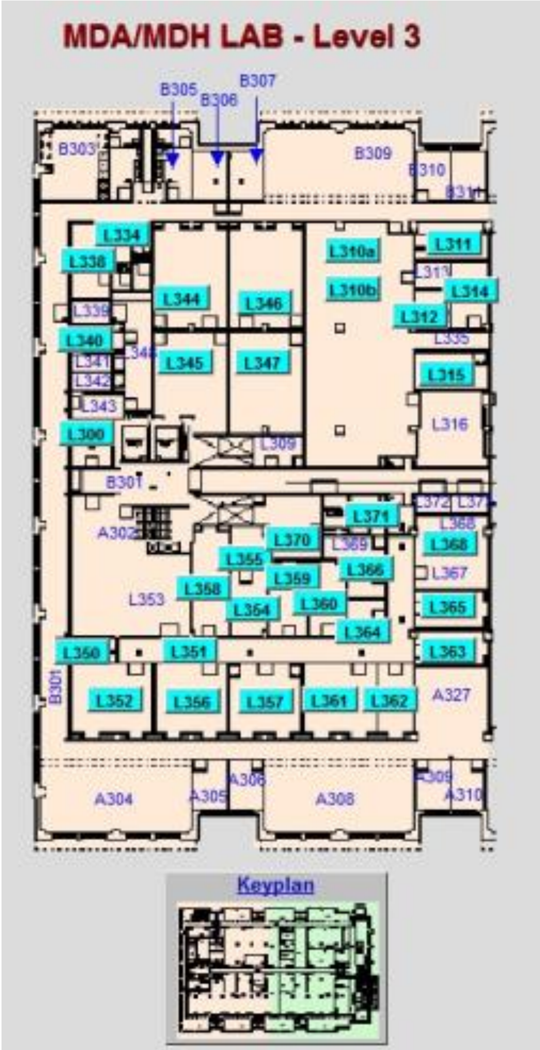
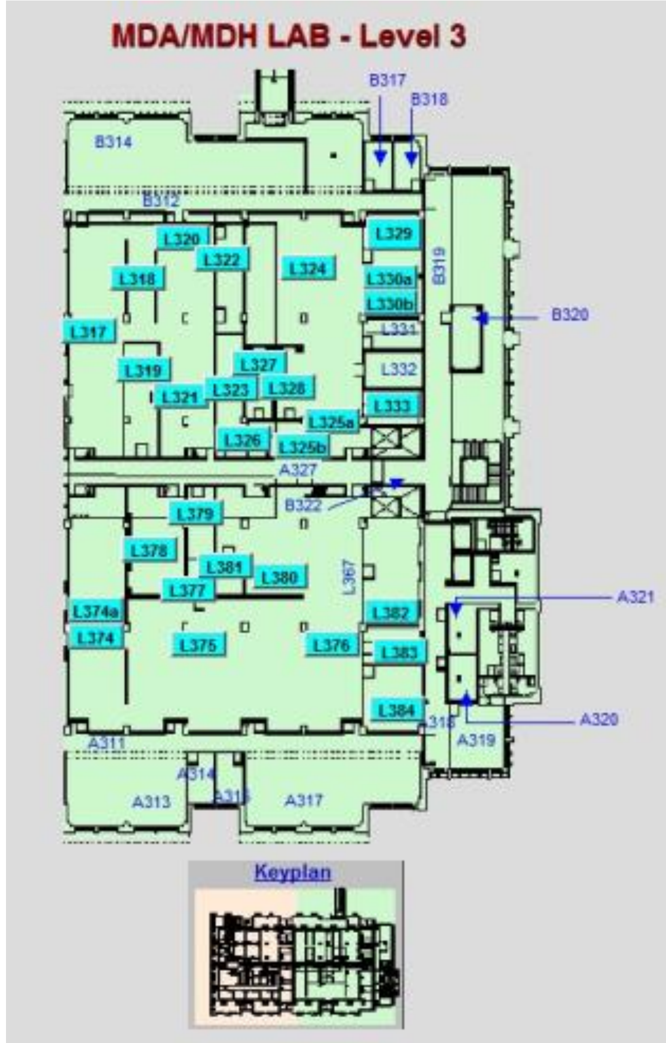
Third Floor





PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	HUH	Horizontal Unit Heater
BAS	Building Automation System	HRU	Heat Recovery Unit
CD	Cold Deck	HW	Hot Water
CDW	Condenser Water	HWDP	Hot Water Differential Pressure
CDWRT	Condenser Water Return Temperature	HWP	Hot Water Pump
CDWST	Condenser Water Supply Temperature	HWRT	Hot Water Return Temperature
CFM	Cubic Feet per Minute	HWST	Hot Water Supply Temperature
CHW	Chilled Water	HX	Heat Exchanger
CHWRT	Chilled Water Return Temperature	kW	Kilowatt
CHWDP	Chilled Water Differential Pressure	kWh	Kilowatt-hour
CHWP	Chilled Water Pump	MA	Mixed Air
CHWST	Chilled Water Supply Temperature	MA Enth	Mixed Air Enthalpy
CRAC	Computer Room Air Conditioner	MARH	Mixed Air Relative Humidity
CUH	Cabinet Unit Heater	MAT	Mixed Air Temperature
CV	Constant Volume	MAU	Make-up Air Unit
DA	Discharge Air	OA	Outside Air
DA Enth	Discharge Air Enthalpy	OA Enth	Outside Air Enthalpy
DARH	Discharge Air Relative Humidity	OARH	Outside Air Relative Humidity
DAT	Discharge Air Temperature	OAT	Outside Air Temperature
DDC	Direct Digital Control	Occ	Occupied
DP	Differential Pressure	PTAC	Packaged Terminal Air Conditioner
DSP	Duct Static Pressure	RA	Return Air
DX	Direct Expansion	RA Enth	Return Air Enthalpy
EA	Exhaust Air	RARH	Return Air Relative Humidity
EAT	Exhaust Air Temperature	RAT	Return Air Temperature
Econ	Economizer	RF	Return Fan
EF	Exhaust Fan	RH	Relative Humidity
Enth	Enthalpy	RTU	Rooftop Unit
ERU	Energy Recovery Unit	SF	Supply Fan
FCU	Fan Coil Unit	Unocc	Unoccupied
FPVAV	Fan Powered VAV	UH	Unit Heater
FTR	Fin Tube Radiation	VAV	Variable Air Volume
GPM	Gallons per Minute	VFD	Variable Frequency Drive
HD	Hot Deck	VIGV	Variable Inlet Guide Vanes
HP	Horsepower	VUH	Vertical Unit Heater

Conversions
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH